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TITLE

Smoking in pregnancy a key factor for sudden infant death among Māori

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Short title

Smoking in pregnancy and Māori sudden infant death

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ABSTRACT

M MacFarlane, JMD Thompson, J Zuccollo, G McDonald, D Elder, AW Stewart, B Lawton, T Percival, N Baker, M Schlaud, P Fleming, B Taylor, EA Mitchell. Smoking in pregnancy a key factor in Māori sudden infant death. *Acta Paediatrica* 2018; XX:XX. Stockholm. ISSN

Aim

To examine the Sudden Unexpected Death in Infancy (SUDI) disparity between Māori and non-Māori in New Zealand.

Methods

A nationwide prospective case-control study ran from March 2012-February 2015. Exposure to established SUDI risk factors was analysed to investigate the disparity experienced by Māori. Infant ethnicity was based on mother's ethnicity. Māori ethnicity was prioritised. Non-Māori includes Pacific, Asian, NZ European and Other.

Results

There were 137 cases and 649 controls. The Māori SUDI rate was 1.41/1,000 live births compared to 0.53/1,000 for non-Māori. Parents/caregivers of 133 cases (97%) and 258 controls (40%) were interviewed.

Smoking in pregnancy was associated with an equally-increased SUDI risk for Māori (adjusted OR=8.11, 95%CI=2.64, 24.93) and non-Māori (aOR=5.09, 95% CI=1.79, 14.47), as was bed-sharing (aOR=3.66, 95% CI=1.49, 9.00 versus aOR=11.20, 95% CI=3.46, 36.29). Bed-sharing prevalence was similar, however more Māori controls smoked during pregnancy (46.7%) than non-Māori (22.8%). The main contributor relating to increased SUDI risk for Māori/non-Māori infants is the combination of smoking in pregnancy and bed-sharing.

Conclusion

The association between known SUDI risk factors, including bed-sharing and/or smoking in pregnancy and SUDI risk, is the same regardless of ethnicity. Māori infants are exposed more frequently to both behaviours because of the higher Māori smoking rate.

Keywords: Māori, SUDI, bed-sharing, smoking, case-control

Key notes

- The combination of smoking in pregnancy and bed sharing is the main contributor relating to increased SUDI risk for Māori and non-Māori infants
- The association between these, and other known SUDI risk factors, and SUDI risk, is the same regardless of ethnicity.
- Māori infants are exposed more frequently to both behaviours because of the higher Māori smoking rate.

INTRODUCTION

Sudden Unexpected Death in Infancy (SUDI) is when an infant under one year of age dies suddenly, usually during sleep and initially without explanation.

SUDI is a broader term used to include SIDS (Sudden Infant Death Syndrome) deaths, which are deaths that remain unexplained even after a thorough investigation comprising full autopsy, clinical history and review of the circumstances of death. This includes a scene examination (1) and deaths where a possible cause may be identified, such as accidental asphyxia (2). Deaths where it may be an expected outcome, such as motor vehicle accidents, are excluded.

New Zealand has one of the highest post-neonatal (28-364 days) mortality rates among developed countries (2,3). There has been a 29% reduction in overall post-perinatal (7-364 days) mortality from 2009 to 2015 (2.8 to 2.0/1000 live births) (4). SUDI rates for Māori have decreased, but remain higher compared with non-Māori (2).

Māori comprise less than a third of live births in New Zealand (5), yet half (49.6%) of the 137 SUDI cases between 2012 and 2015 were Māori (1.41 per 1,000 live births) and overall, infants of Māori mothers were at an almost three-fold risk of SUDI compared with infants of non-Māori/non-Pacific mothers (6).

The New Zealand Cot Death Study (1987-1990) identified key risk factors for SIDS and found that the higher SIDS rate among Māori, at that time, could be explained primarily by the higher exposure of Māori infants to smoking in pregnancy, bed sharing and their combination compared with non-Māori infants(7).

The SUDI Nationwide Study (2012-2015) (6) reinvestigated the risk factors identified in the New Zealand Cot Death Study and specifically focussed on the sleep environment, which is crucial to the understanding of unexpected infant deaths.

The aim of the current study is to examine the continuing disparity between Māori and non-Māori SUDI using data from the SUDI Nationwide Study. We hypothesised that the higher rates in Māori are due to the continuing higher prevalence of the combination of smoking and bed sharing.

METHODS

The prospective case-control SUDI Nationwide Study was conducted across New Zealand from March 2012 to February 2015. Study methods and overall results have been reported in detail (6).

Cases

In New Zealand, sudden, unexplained or unnatural deaths are referred to the Ministry of Justice for investigation by a coroner to identify causes and circumstances of death, make recommendations to prevent similar deaths and to promote justice (8).

During the study, infant deaths referred to the coroner were reviewed by the National Initial Investigation Office (NIIO). Deaths that appeared to meet the inclusion criteria were forwarded to the study project manager (MM). If NIIO staff were unsure whether a case was in scope, they notified the project manager who sought advice, if necessary, from the Principal Investigator (EAM).

Data on coronial infant deaths in the previous month and during the entire study were received from the Ministry of Justice, which enabled the project team to verify whether the criteria for cases were appropriately applied.

Autopsies are performed in most SUDI cases by forensic or paediatric/perinatal pathologists. Autopsies followed a standard protocol modified from the International SUDI Protocol to align with cultural guidelines and the New Zealand Coroners Act (8).

Allocation of a cause of death

To classify cause of death for each case, an expert group met and reviewed the study datasets and pathology reports. The group comprised two pathologists, two paediatricians, a public health physician and the project manager. This process

occurred independently from the certified cause of death or the cause of death determined by the coroner.

Case definition

The following deaths were included:

- Clear asphyxia deaths occurring during sleep
- Unsafe sleeping i.e. bed sharing with no direct evidence of facial occlusion, wedging, sleeping on couch or in car seat
- Congenital anomalies, infection and other findings insufficient to explain the death
- Unascertained, and
- Unexplained causes of sudden unexpected death (in the presence of a normal history, autopsy and scene investigation, or SIDS)

The following deaths were excluded:

- Non-accidental injury, including suspected homicide and neglect, obvious accidental causes and concealed pregnancies
- No autopsy (due to parental objection)
- Perinatal asphyxia, antenatal problems and complications of prematurity
- Clearly identified cause at autopsy with prodromal symptoms and signs
- Congenital anomalies that clearly led to death

Controls

Based on the distribution and characteristics of SUDI cases in New Zealand between 2003 and 2007, controls were randomly sampled and frequency matched to cases by obstetric hospital of birth, sex, mother's ethnicity and age at death.

Infants were selected from hospital birth registers of each District Health Board (DHB) according to these criteria by a midwife or local coordinator of the DHB Perinatal Maternal Mortality Review Committee (PMMRC). Selecting infants in this way ensured the distribution and characteristics of cases and controls were similar with regards to hospital of birth, ethnicity, sex and age.

Data collection

Data were collected through face-to-face interviews with parents/caregivers, usually the infants' mothers, who were responsible for the infant during the last sleep (cases) or nominated sleep (controls). Interviews were conducted by trained SUDI Liaison personnel and occurred at a time and place preferred by participants, usually at the family home. Each interview lasted 90-120 minutes. Occasionally, a second interview was necessary, for example, if one person placed the infant to sleep and another person found the infant unresponsive or awake, and this second person was unavailable at the first interview. Interviews were based on detailed, health-focused questionnaires that were virtually identical, except for the language around the last sleep (cases) or nominated sleep (controls).

During interviews, each mother self-identified her ethnicity/ethnicities (9). This report uses prioritised ethnicity to give a single ethnic group to each mother for the purpose of analysis. Infants of Māori mothers are subsequently referred to as Māori infants. Māori is prioritised over all other ethnicities and is followed by Pacific, Asian and NZ European/Other (9). Non-Māori includes Pacific, Asian, NZ European and Other ethnicities.

Recruitment of participants

All families received a letter with information about the study and an invitation to participate. Separate letters were developed for cases and controls.

Follow-up telephone calls to control families were made within two weeks of the letter being sent. The calls provided opportunity to speak with parents/caregivers to clarify and/or provide information, repeat the invitation and arrange a time for an interview. In areas where families were highly transient, initial contact with control families was made by telephone, which enabled the accuracy of contact details to be confirmed quickly. The letter was delivered in person at the time of the control interview.

Case families were initially contacted by telephone and received their letters at the interview.

Explanatory variables

The study investigated infant sleeping practices, antenatal and postnatal health and current living situation. Well Child-Tamariki Ora records, obstetric and medical records, where available, were reviewed, and a set of objective measures was obtained which included photographs of the sleep scene reconstruction (not part of this report).

Study size

All SUDI cases in New Zealand between 1 March 2012 and 28 February 2015 that met the SUDI criteria were eligible for the study. Based on previous SUDI mortality data (10), 210 SUDI cases were expected across the 36-month study period and a sample of 420 controls. If a risk factor had a prevalence of 20% in the control population, the study would be able to detect an odds ratio of 1.73 with a power of 80% at a level of significance of 5%.

However, the participation rate of controls was lower than expected, so if a selected control could not be obtained, then a further control was selected. In total, 649 controls were selected.

Statistical methods

Univariable and multivariable analyses were undertaken to examine the relationships between variables for Māori and non-Māori. Unconditional multivariable logistic regression was used to adjust for potential confounders and determine the presence of interactions. The association of risk factors with SUDI was estimated using odds ratios with a 95% confidence interval.

Analyses were carried out in SAS (Version 9.3, SAS Institute, Carry, NC, USA). This study applies the same statistical modelling used for the original publication based on these data (6).

SUDI mortality calculations were based on the number of live births in New Zealand between 2012 and 2014(5). Population attributable risks (PAR) (11) were calculated for potentially modifiable risk factors.

Ethics approval

Ethics approval for the study was obtained from the Central Region Ethics Committee (CEN/11/09/045) and from selected DHBs to allow the study to receive information about infants selected as controls. All parents/caregivers provided informed written consent.

RESULTS

During the study, 303 infant deaths referred to the coroner were considered for inclusion. One-hundred and thirty-seven deaths (45%) met the criteria for inclusion and of these, 97% (n=133) of parents/caregivers were interviewed. Figure 1 shows the flow of cases referred to the coroner and gives the reasons for exclusion.

The 137 eligible cases were categorised in the following way:

- Clear asphyxia mechanism (n=20)
- Unsafe sleeping (n=50)
- Unsafe sleeping with minor findings not thought to have contributed to the death (n=18)
- Presence of minor findings not thought to have contributed to the death, with no evidence of unsafe sleeping (n=13)
- Unexplained (n=36)

In total, 649 infants were selected for the control group and 258 (40%) participated in the study. Of the 391 mothers that were selected but did not participate in the study, 182 were uncontactable and 209 actively or passively refused to participate. Passive refusals included those that initially agreed to participate but then cancelled last-minute or were not at the agreed interview location and/or dropped out of contact.

A breakdown of the number of participants selected, interviewed and excluded from the control group is shown in Figure 2.

Māori infants comprised 49.6% of cases and 52.3% of controls. During the study, the SUDI mortality rate for Māori was 1.41 per 1,000 live births compared to 0.53/1,000 for non-Māori. The overall SUDI rate was 0.76/1,000.

Magnitude of risk factors by ethnicity

Univariable and multivariable odds ratios (OR) for sociodemographic, maternal, pregnancy, infant and infant care practice variables for Māori and non-Māori cases and controls are shown in Table 1 - Supporting Information (available at www.addURL.com). We adjusted for marital status.

Smoking during pregnancy was associated with a significantly increased risk of SUDI for Māori and non-Māori infants (Māori: adjusted OR=8.11, 95% CI=2.64, 24.93, and non-Māori: aOR=5.09, 95% CI=1.79, 14.47), as was bed sharing (Māori: aOR=3.66, 95% CI=1.49, 9.00; non-Māori aOR=11.20, 95% CI=3.46, 36.29). The magnitude of the risk did not differ by ethnicity (univariable interaction $\chi 2$ =0.35, p=0.55 and $\chi 2$ =0.00, p=1.00 respectively).

The effect of the combination of bed sharing and smoking in pregnancy for Māori and non-Māori was examined (Table 2). The risk for infants of mothers who smoked during pregnancy and bed-shared was far greater than the risk for infants not exposed to smoking in pregnancy and bed sharing for both Māori and non-Māori (Māori: aOR=22.71, 95% CI=5.69, 90.68; non-Māori: aOR=97.15, 95% CI=15.50, 608.80).

The odds ratios for prone sleep position (Table 1) for Māori (aOR=5.45, 95% CI=0.87, 34.22) and non-Māori (aOR=3.45, 95% CI=0.56, 21.16) were not statistically significantly different (interaction $\chi 2$ =5.72, p=0.06); neither were the odds ratios for Māori and non-Māori infants not sharing the parental bedroom (aOR=1.72, 95% CI=0.71, 4.19 vs aOR=6.31, 95% CI=2.03, 19.56 respectively; interaction $\chi 2$ =0.60, p=0.44).

Prevalence of risk factors in controls

Māori mothers in the control group were less likely to be married (p<0.0001), and more likely to have smoked in pregnancy (p<0.0001) than non-Māori mothers in the

control group. The prevalence of all other risk factors did not differ significantly between Māori and non-Māori (Table 3).

The prevalence of bed sharing among Māori and non-Māori controls was similar at 18.5% and 17.1% respectively (p=0.76); however, fewer non-Māori infants were exposed to the combination of smoking in pregnancy and bed sharing compared with Māori (3.3% vs 9.6%, p=0.046). Overall, 63.4% of non-Māori infants in the control group were not exposed to either bed sharing or smoking in pregnancy compared with 44.4% of Māori infants.

Population attributable risk

The population attributable risk (PAR) results in Table 4 indicate the percentage by which SUDI could be reduced if Māori and non-Māori populations were unexposed to specific factors, compared with current levels of exposure, assuming that the factor was causally related to SUDI.

As the magnitude of the odds ratios for smoking in pregnancy and bed sharing do not differ for Māori or non-Māori, PAR calculations using the all-ethnicities odds ratios reported by Mitchell et al (6) provide a more accurate estimate of the magnitude of the risk; and indicates that the PAR is being driven entirely by the difference in the magnitude of exposure.

The PAR for smoking in pregnancy for Māori and non-Māori was 67% and 49% respectively. For bed sharing, it was 49% for Māori and 47% for non-Māori. Māori infants not sharing the parental bedroom had a PAR of 19% compared to 29% for non-Māori. The PAR for the combination of smoking in pregnancy and bed sharing was 74% for Māori and 50% for non-Māori.

DISCUSSION

Māori had the highest SUDI rate of 1.41/1,000 (49.6% of all cases) compared to 0.53/1,000 for non-Māori. Smoking in pregnancy was more prevalent among Māori cases and controls (86.7% and 46.7%) than non-Māori (61.9% and 22.8%). Bed sharing has been described as a dynamic, cultural practice among certain ethnic groups, including Māori (12). Unexpectedly, and in contrast to the New Zealand Cot Death Study, the prevalence of bed sharing was similar for Māori and non-Māori cases and controls (Māori: 58.7% and 18.5% respectively; non-Māori 56.3% and 17.1%). Bed sharing prevalence was consistent with a previous local study reporting that 17% of six-week-old infants sometimes bed shared (13).

The interaction between bed sharing and smoking in pregnancy showed no difference in the magnitude of the risk between Māori and non-Māori. Thus, the risk for infants from bed sharing and smoking combined is the same, regardless of ethnicity. We have previously reported that the risk of SUDI is 32-times higher than the risk for infants not exposed to bed sharing or smoking in pregnancy (6). The higher prevalence of smoking in Māori means that Māori infants are more likely to be exposed to the dangerous combination of bed sharing and smoking, as illustrated in the control group where 9.6% of Māori infants were exposed to both risk factors compared with 3.3% of non-Māori infants.

Overall, there was no statistical difference between Māori and non-Māori cases and controls with regard to number of previous live births, maternal age, being a twin, sex of the infant, birthweight, front and side sleep position, ever having breastfed, sharing the parental bedroom and bed sharing.

Strengths and Limitations

The high participation rate among cases (97%) was a key strength of the study, as was the fact that only one case was excluded due to no post mortem examination.

Limitations included fewer cases (n=137) than the 210 expected during the study, which reduced the power to detect the odds ratios planned; this was partially tempered by an increased control ratio.

The reduced number of cases represents a reduction in SUDI deaths across the study period (4). Contributing to this is the Safe Sleep Programme, which provides universal education and supplies safe sleep devices to families in specific areas and to infants with greater exposure to known SUDI risk factors (4). Safe sleep devices include traditionally-woven Māori flax baskets called wahakura, and specially-designed lined plastic containers called Pepi-Pods®. Wahakura and Pepi-Pods® were developed in New Zealand specifically to support safe infant sleep and infant bed sharing.

Having fewer SUDI cases in the study affected the ability to identify differences between the case and control groups. Due to our interest in the differences between both groups, families in the control group were selected using previous SUDI mortality data to maximise internal validity and enable the comparison of groups with similar characteristics.

Because SUDI had occurred more frequently among families in lower socioeconomic areas, Māori populations and smokers, the control group reflects a higher proportion of SUDI risks than those in a nationally representative sample. As has been seen previously, controls selected from groups with greater risks and lower socioeconomic status, were less likely to participate (14). Transiency and turnover of mobile telephones were high among the control group. Overall, 60% of selected controls did not participate.

A potential limitation is that disparities in the clinical pathways experienced by Māori mothers in this study were not examined. Previous studies have shown that Māori mothers are less likely to attend antenatal services (15) or they attend late, after the

first trimester (16, 17). Māori mothers are also more likely to receive lesser quality of care from health services (18). Mothers who are unmarried, high parity, of low socioeconomic status and low educational attainment are also more likely to have reduced uptake of antenatal services and to experience inadequate antenatal care, which is associated with poor clinical outcomes (17, 19, 20).

In contrast, adequate and early uptake of antenatal services provides the opportunity for health screening, education and interventions (21, 22), such as smoking cessation and infant safe sleep advice. In this study, those who refused or did not participate are more likely to be in this group. The low participation rate among the control group provides a proxy marker of reduced access and uptake to antenatal services and healthcare in general, and of the increased prevalence of higher risk behaviours.

The very high risk of SUDI from the combination of smoking in pregnancy and bed sharing is highlighted by the population attributable risk for Māori, which suggests that 74% of Māori SUDI could be prevented if the combination of these two behaviours was eliminated or the link was broken. For non-Māori, the potential reduction in SUDI from not smoking in pregnancy or not bed sharing or from avoiding both behaviours is 50%, due to the lower prevalence of risk factors in this group.

This study compares Māori with non-Māori, rather than with non-Māori/non-Pacific. Several reasons underpin this approach. Māori is the most adversely-affected ethnic group in New Zealand in relation to SUDI. Māori experience systemic disparities and poorer health outcomes than the non-Māori population (23-28) and improving health outcomes for Māori is a government priority. This extends to entities such as DHBs, which have a statutory responsibility for reducing Māori health inequalities (23, 25-28). Māori are indigenous to New Zealand and the Treaty of Waitangi (the Treaty) is one of New Zealand's founding documents. The principles of the Treaty

are embedded into Government policy and strategy in acknowledgement of the Crown's obligations as a Treaty partner (23, 28). In recognition of this historical and contemporary context, this study has prioritised its focus on the SUDI disparities experienced by Māori. This does not detract from the burden of SUDI experienced by Pacific families, whose rate is second to Māori. However, the small number of Pacific infants in the study limits our ability to draw meaningful conclusions. To support the government's goal of reducing the SUDI rate to 0.1/1,000 by 2025 (29) the Ministry of Health has funded a new national SUDI prevention programme to coordinate and report nationally on evidence- and outcomes-based SUDI prevention efforts. While SUDI has long been a significant health inequity for Māori, there is now increased potential to reduce the SUDI disparity experienced by Māori.

Conclusion

This analysis found that the magnitude of risk for the factors examined did not differ between Māori and non-Māori, although, the prevalence of being unmarried and smoking in pregnancy was higher among Māori. This reinforces the view that ethnicity per se is not a risk factor for SUDI (7).

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And most importantly, the infants and families that participated in the study and/or have been affected by SUDI.

Terms and Abbreviations

aOR	Adjusted odds ratio
CI	Confidence interval
Mihi	Greetings (Māori)
NIIO	National Initial Investigation Office, Ministry of Justice
OR	Odds ratio
PAR	Population attributable risk
Pepi-Pod®	Plastic bassinet to support safe infant sleep
PMMRC	Perinatal and Maternal Mortality Review Committee
SIDS	Sudden infant death syndrome
SUDI	Sudden unexpected death in infancy
Wahakura	Traditionally-woven Māori flax bassinet to support safe infant sleep
Whānau	Family, including extended family (Māori)

Conflicts of interest

The authors report no conflicts of interest.

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Table 1: see Supporting Information

Table 2: Bed sharing and smoking in pregnancy combinations and the risk of SUDI for Māori and non-Māori

		Māori				**Non-Māori**			
		Cases	**Controls**	**Univariable**	**Multivariable***	**Cases**	**Controls**	**Univariable**	**Multivariable***
Smokingin pregnancy	**Bed-sharing**			**p<0.0001**	**p<0.0001**			**p<0.0001**	**p<0.0001**
No	No	6 (10.0)	60 (44.4)	Reference	Reference	15 (23.8)	78 (63.4)	Reference	Reference
No	Yes	2 (3.3)	12 (8.9)	1.67 (0.30, 9.27)	0.52 (0.05, 5.75)	9 (14.3)	17 (13.8)	2.75 (1.03, 7.33)	3.60 (10.87, 14.96)
Yes	No	20(33.3)	50 (37.0)	4.00 (1.50, 10.73)	3.91 (1.12, 13.62)	12 (19.1)	24 (19.5)	2.6 (1.07, 6.31)	1.55 (0.40, 5.97)
Yes	Yes	32 (53.3)	13 (9.6)	24.62	22.71	27 (42.9)	4 (3.3)	35.10	97.15

				(8.54, 70.92)	(5.69, 90.68)			(10.71, 114.97)	(15.50, 608.80)

*Bed sharing and smoking in pregnancy combinations were adjusted for ethnicity, marital status, number of previous live births, maternal age, smoking in pregnancy, multiple birth, sex, birthweight, age of infant, position placed to sleep, breastfeeding and sharing parental bedroom.

Table 3: see Supporting Information

Table 4: Proportion of the population exposed to risk (p), relative risk (OR) and population attributable risk (PAR) for Māori and non-Māori seen in this study.*The odds ratios used in Table 4 relate to the all-ethnicity odds ratios reported by Mitchell et al (6)

		Māori		**Non-Māori**	
	OR*	**p**	**PAR**	**p**	**PAR**
Smoking in pregnancy	5.28	0.467	0.67	0.228	0.49
Bed sharing	6.23	0.185	0.49	0.171	0.47
Not sharing parental bedroom	1.84	0.282	0.19	0.350	0.29
Smoking in pregnancy/bed sharing	31.1	0.096	0.74	0.033	0.50

*The odds ratios used in Table 4 relate to the all-ethnicity odds ratios reported by Mitchell et al (6)

Legend for figures

1. Participants in Case group
2. Participants in Control group

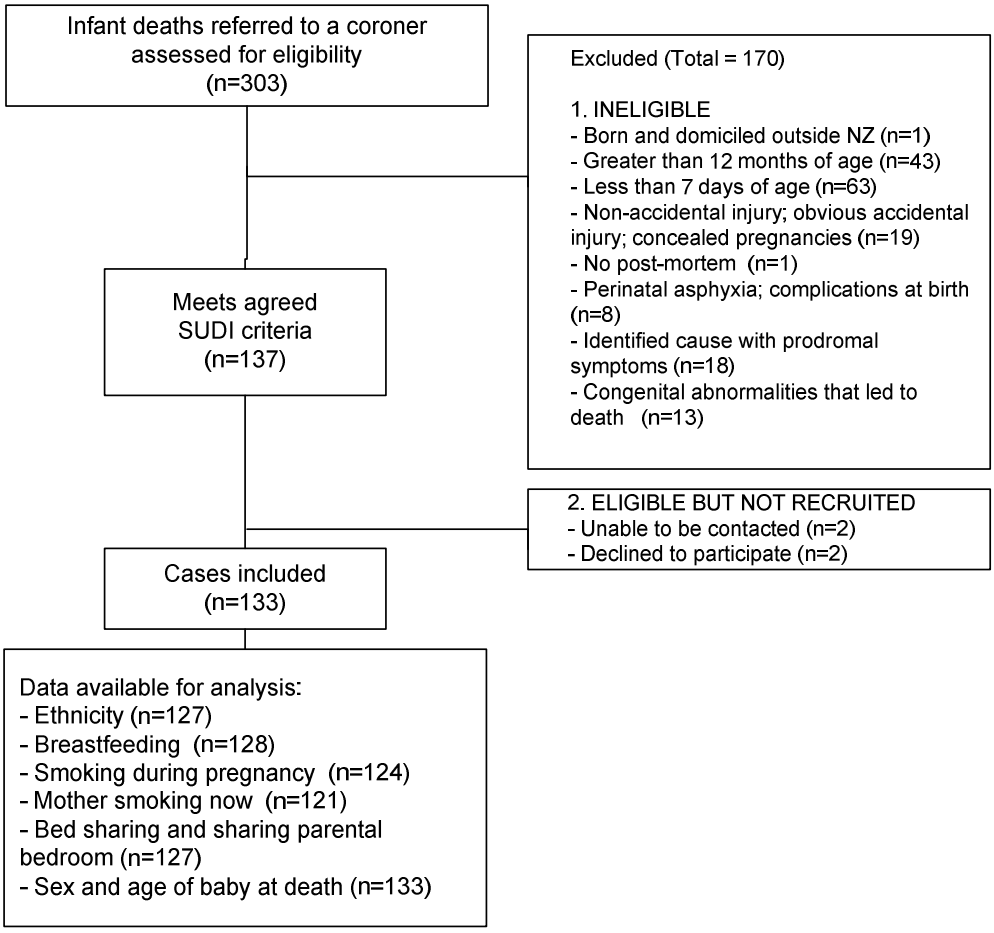

Figure 1: Participants in Case group

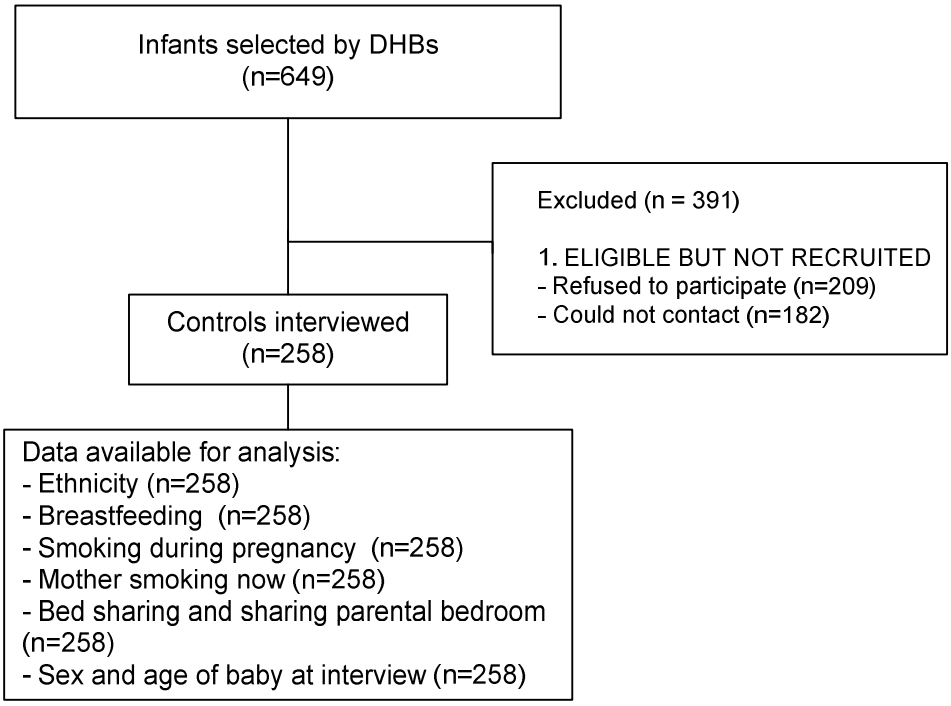

Figure 2: Participants in Control group

Separate document entitled: "Table_1_SuppInfo"

Table1 – The number (percentage) or mean (SD) and univariable and multivariable odds ratios (95% CI) of sociodemographic, pregnancy, infant and infant care practice variables by Māori and non-Māori. Interactions shown in heading lines are univariable.

	Māori				Non-Māori			
Variable	**Cases N (%)**	**Controls N (%)**	**Univariable OR (95% CI)**	**Multivariable OR (95% CI)**	**Cases N (%)**	**Controls N (%)**	**Univariable OR (95% CI)**	**Multivariable OR (95% CI)**
Marital Status (missing=23)								
			p=0.09	p=0.94			**p=0.009**	p=0.51
Married	3 (5.4)	25 (18.5)	Reference	Reference	16 (28.6)	64 (52.9)	Reference	Reference
Cohabiting	31 (55.4)	64 (47.4)	4.03 (1.13, 14.40)	0.89 (0.16, 4.87)	22 (39.3)	36 (29.8)	2.44 (1.14, 5.24)	1.94 (0.63, 5.94)
Single	22 (39.3)	46 (34.1)	3.98 (1.09, 14.62)	1.04 (0.18, 5.98)	18 (32.1)	21 (17.4)	3.43 (1.49, 7.90)	1.36 (0.39, 4.72)
Number of previous live births (missing=13)								
			p=0.0001	p=0.06			**p=0.005**	p=0.25
0	31 (50.8)	25 (18.5)	Reference	Reference	32 (54.2)	34 (27.6)	Reference	Reference
1	8 (13.1)	31 (23.0)	0.21 (0.08, 0.53)	0.18 (0.05, 0.67)	6 (10.2)	31 (25.2)	0.21 (0.08, 0.56)	0.24 (0.06, 0.99)
2	7 (11.5)	19 (14.1)	0.30 (0.11, 0.82)	0.37 (0.09, 1.50)	9 (15.3)	22 (17.9)	0.44 (0.17, 1.08)	0.82 (0.22, 3.04)
3+	15 (24.6)	60 (44.4)	0.20 (0.09, 0.44)	0.34 (0.10, 1.14)	12 (20.3)	36 (29.3)	0.35 (0.16, 0.80)	0.63 (0.18, 2.16)
Maternal age at birth (mean years, SD) (missing=11)								
			p=0.004	p=0.16			**p=0.0004**	p=0.224
Age in years	24.9 (6.6)	28.0 (7.0)	0.93 (0.89, 0.98)	0.95 (0.88, 1.02)	25.8 (6.4)	29.5 (6.1)	0.91 (0.86, 0.96)	0.95 (0.88, 1.03)
Smoking during pregnancy (missing=9)							Univariable interaction x^2 =0.35, p=0.55	
			p<0.0001	**p=0.0003**			**p<0.0001**	**p=0.002**

	Māori				Non-Māori			
No	8 (13.3)	72 (53.3)	Reference	Reference	24 (38.1)	95 (77.2)	Reference	Reference
Yes	52 (86.7)	63 (46.7)	7.57 (3.35, 17.13)	8.11 (2.64, 24.93)	39 (61.9)	28 (22.8)	5.51 (2.85, 10.67)	5.09 (1.79, 14.47)
Multiple birth (missing=5 cases)								
			p=0.28	p=0.49			p=0.98	p=0.98
No	60 (93.75)	131 (97.0)	Reference	Reference	60 (93.8)	123 (100)	Reference	Reference
Yes	4 (6.25)	4 (3.0)	2.18 (0.53, 9.03)	2.23 (0.23, 22.00)	4 (6.3)	0 (0)	Undefined	Undefined
Infant sex (missing=0)								
			p=0.25	p=0.78			p=0.78	p=0.08
Female	29 (43.9)	48 (36.6)	Reference	Reference	27 (40.3)	47 (38.2)	Reference	Reference
Male	37 (56.1)	87 (64.4)	0.70 (0.39, 1.28)	0.88 (0.37, 2.09)	40 (59.7)	76 (61.8)	0.92 (0.50, 1.68)	0.42 (0.16, 1.11)
Birthweight (mean gms, SD) (missing n=14)								
			p=0.0004	p=0.33			**p=0.005**	p=0.21
Weight in grams	3049.6 (619.3)	3414.2 (614.0)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)	3265.2 (605.3)	3523.0 (538.4)	1.00 (1.00, 1.00)	1.00 (1.00, 1.00)
Position placed to sleep (missing=7) Univariable interaction x^2 =5.72, p=0.06								
			p<0.0001	**p=0.029**			p=0.63	p=0.41
Back	38 (59.4)	118 (87.4)	Reference	Reference	45 (72.6)	97 (78.9)	Reference	Reference
Side	18 (28.1)	11 (8.2)	5.08 (2.21, 11.71)	3.73 (1.07, 13.06)	13 (21.0)	20 (16.3)	1.40 (0.64, 3.07)	1.19 (0.32, 4.39)
Front	8 (12.5)	6 (4.4)	4.14 (1.35, 12.69)	5.45 (0.87, 34.22)	4 (6.5)	6 (4.9)	1.44 (0.39, 5.35)	3.45 (0.56, 21.16)
Ever breastfed (missing=5) Univariable interaction x^2 =1.38, p=0.24								
			p=0.22	p=0.58			**p=0.028**	p=0.10

			Māori				Non-Māori	
Yes	57 (89.1)	127 (94.1)	Reference	Reference	58 (90.6)	121 (98.4)	Reference	Reference
No	7 (10.9)	8 (5.9)	1.95 (0.68, 5.64)	0.56 (0.07, 4.34)	6 (9.4)	2 (1.6)	6.26 (1.23, 31.96)	6.03 (0.72, 50.73)
Sharing the parental bedroom (missing=6) Univariable interaction x^2 =0.60, p=0.44								
			p=0.014	p=0.23			p=0.17	**p=0.001**
Yes	34 (54.0)	97 (71.9)	Reference	Reference	35 (54.7)	80 (65.0)	Reference	Reference
No	29 (46.0)	38 (28.2)	2.18 (1.17, 4.05)	1.72 (0.71, 4.19)	29 (45.3)	43 (35.0)	1.54 (0.83, 2.85)	6.31 (2.03, 19.56)
Bed sharing (missing=6) Univariable interaction x^2 =0.00, p=1.0								
			p<0.0001	**p=0.005**			**p<0.0001**	**p<0.0001**
No	26 (41.3)	110 (81.5)	Reference	Reference	28 (43.8)	102 (82.9)	Reference	Reference
Yes	37 (58.7)	25 (18.5)	6.26 (3.23, 12.16)	3.66 (1.49, 9.00)	36 (56.3)	21 (17.1)	6.25 (3.16, 12.35)	11.20 (3.46, 36.29)

Bold indicates significant at the 5% level. *Variables in model: ethnicity, marital status, number of previous live births, maternal age, smoking in pregnancy, multiple birth, sex, birthweight, age of infant, position placed to sleep, ever breastfed, sharing parental bedroom and bed sharing.

Separate document entitled: "Table_3_SupplInfo"

Table 3. – Comparison of the prevalence of risk factors for SUDI in controls by Māori and non- Māori

Variable	Māori, n (%) N=135	Non-Māori, n (%) N=123
Marital Status (missing=2)x^2=33.59, **p<0.0001**		
Married	25 (18.5)	64 (52.9)
Cohabiting	64 (47.4)	36 (29.8)
Single	46 (34.1)	21 (17.4)
Number of previous live births (missing=0)x^2=7.05, p=0.07		
0	25 (18.5)	34 (27.6)
1	31 (23.0)	31 (25.2)
2	19 (14.1)	22 (17.9)
3+	60 (44.4)	36 (29.3)
Maternal age at birth in mean years (SD) (missing=0)t= -1.84, p=0.07		
Age in years	28.0 (7.0)	29.5 (6.1)
Smoking during pregnancy (missing=0)x^2=16.11, **p<0.0001**		
No	72 (53.3)	95 (77.2)
Yes	63 (46.7)	28 (22.8)
Multiple birth (missing=0) x^2=3.70, Fisher exact p=0.15		
No	131 (97.0)	123 (100)
Yes	4 (3.0)	0 (0)
Infant sex (missing=0)x^2=0.20, p=0.66		
Female	48 (36.6)	47 (38.2)
Male	87 (64.4)	76 (61.8)
Birthweight in mean gms (SD)t = -1.52, p=0.13		
Weight in grams	3414.2 (614.0)	3523.0 (538.4)
Age of infant in mean weeks (SD)t =0.39, p=0.70		
Age in weeks	15.1 (11.0)	15.6 (9.6)
Position placed to sleep (missing=0)x^2=4.12, p=0.13		
Back	118 (87.4)	97 (78.9)
Side	11 (8.2)	20 (16.3)
Front	6 (4.4)	6 (4.9)
Ever breastfed (missing=0)x^2=3.19, p=0.07		
Yes	127 (94.1)	121 (98.4)
No	8 (5.9)	2 (1.6)

Variable		Māori, n (%) N=135	Non-Māori, n (%) N=123
Sharing the parental bedroom (missing=0) x^2= 1.39 p=0.24			
Yes		97 (71.9)	80 (65.0)
No		38 (28.2)	43 (35.0)
Bed sharing (missing=0) x^2=0.09, p=0.76			
No		110 (81.5)	102 (82.9)
Yes		25 (18.5)	21 (17.1)
Bed sharing and smoking in pregnancy n(%) x^2 =3.48, p=0.32			
Smoking in pregnancy	**Bed sharing**		
No	No	60 (44.4)	78 (63.4)
No	Yes	12 (8.9)	17 (13.8)
Yes	No	50 (37.0)	24 (19.5)
Yes	Yes	13 (9.6)	4 (3.3)